

and light frost in the San Joaquin Valley. From the 24th to the 29th low temperatures prevailed in the Southern States, with light to heavy frosts in the interior of the Gulf and South Atlantic States.

Injury to fruit buds and blooms by frost was reported in northern Texas, Oklahoma, Tennessee, and the Ohio Valley.

In the North Pacific coast States frost was frequently reported during the last half of the month.

The frosts of the month were anticipated by the regular forecasts and special warnings of the Weather Bureau.

At the close of February the rivers of the Ohio Valley and the Gulf States had risen to flood stages, and the Mississippi River had passed the danger line from the mouth of the Ohio River to the Gulf of Mexico. At Cairo, Ill., the river rose to a maximum stage of 50.6 feet on the 15th, 16th, and 17th; at Memphis, Tenn., to a stage of 40.1 feet on the 20th; at Arkansas City, Ark., to a stage of 53 feet on the 27th and 28th; at Greenville, Miss., to a stage of 49.1 feet on the 27th; at Vicksburg, Miss., to a stage of 51.8 feet on the 27th and 28th, after which dates the river began to subside. At New Orleans, La., the river rose to a stage of 20.3 feet by the 31st. At all of the points named, excepting Cairo and Vicksburg, the river stages reached were the highest on record.

Special bulletins and advices regarding the present and anticipated stages of the Ohio and Mississippi rivers were issued and telegraphed throughout the affected districts preceding the floods and during their continuance. The timeliness and accuracy of the forecasts permitted the adoption of all possible means to protect life and to guard against loss of property.

Recognizing, early in the month, the seriousness of the situation, the official in charge of the Weather Bureau office at New Orleans, La., issued on the morning of the 9th, the following warning of the unprecedented high water:

The Mississippi River is now within one and four-tenths feet of the highest water ever recorded, and the Atchafalaya within one foot of the highest water on record. These rivers will continue to rise slowly during the next three or four weeks and all interests are advised to prepare for a stage of twenty-one feet at New Orleans and a corresponding rise in the Atchafalaya if levees hold volume of water now coming.

The following comments have been made by the New Orleans daily press with regard to this and subsequent warnings issued for the lower Mississippi Valley:

The Times-Democrat, March 16, 1903:

Barely a week has passed since the above warning was issued and the river has risen 1.2 feet and is already within 1.7 feet of the stage predicted. When the warning was first issued there were those who were inclined to doubt a record-breaking flood, but previous warnings of the Weather Bureau had been so accurate that the levee boards began strengthening the levees for a 21-foot stage. Present stages of the river indicate that preparations for the stage named in the warnings were not commenced too soon, and if the water is held within the levees from Vicksburg south, the timely warnings of the Weather Bureau must come in for their share of credit along with the efficiency of the recent improvements of the levees.

The Times-Democrat, March 16, in an editorial advised the levee board as follows:

It must now be clear, however, that the board should not relax its efforts to strengthen the levees in this district. The river, which is already high, will certainly rise even higher within the next fortnight. Indications are now plentiful that the waters which touch the gage at 19.3 feet will, before April 1, go as high as 21 feet. In its official report the Weather Bureau has warned the public to prepare for such a rise. This warning can not be disregarded with impunity.

The Daily Picayune, March 30, 1903:

The conditions now in the Mississippi and its tributaries stand as a testimonial to the timely and accurate warnings issued by the United States Weather Bureau three weeks ago to-day. Too much can not be said in commendation for such efficient and valuable warnings. These warnings have added much to the already great popularity of the weather service in this section.

The Times-Democrat, March 30, 1903:

The lower Mississippi River and tributaries are practically at stages

forecasted by the United States Weather Bureau three weeks ago. Preparations which have been made by the public to meet these high waters show the great value of such timely and accurate warnings.

#### BOSTON FORECAST DISTRICT.

The weather was phenomenally mild, the monthly mean temperature over the district ranging from 4° to 13° above the normal. There was much cloudy weather, and the precipitation, which was chiefly in the form of rain, was considerably in excess of the monthly normal. A conspicuous feature of the weather was the absence of high winds and severe gales along the coast, which are of common occurrence in March in New England. Only four storm warnings were issued during the month and no storms occurred for which warnings were not issued.—*J. W. Smith, Forecast Official.*

#### NEW ORLEANS FORECAST DISTRICT.

Taken as a whole, March was mild, and but one general storm crossed this district during the month. Cold-wave warnings were ordered for Oklahoma and the northwestern portion of east Texas the evening of the 18th and storm south-east warnings were ordered for the Texas coast. On the 19th cold-wave warnings were extended to Arkansas and storm warnings changed to northwest on the Texas coast.

The feature of greatest interest in the eastern portion of this district during the month was the river warnings. On the 7th interests were advised to prepare for a stage of 20 feet, or higher, at New Orleans. Warnings for stages of 39 feet at Melville and 37 feet at Alexandria were issued on the 12th, and for 45 feet at Monroe were issued on the 14th.

Notwithstanding there are several crevasses above here, the river had for several days been oscillating between 20.1 and 20.4 feet. The highest stage in the other rivers was as follows: Melville, La., 38.5 feet, 31st, and rising; Alexandria, 36.2 feet, 27th; Monroe, La., 44.5 feet, 26th to 28th. The above were practically the stages forecast two to four weeks in advance. Warnings were repeated by mail from day to day with such changes as conditions called for. The situation along the Mississippi at the close of March was very critical. Much valuable land was under water and fully thirty days' continuation of high water was in sight. It was impossible at that time to form any estimate as to what the damage would amount to. Eventually it was found to be considerable, and it would have been much greater had the warning for a stage of 21 feet at New Orleans been deferred another week. The warning was distributed on the morning of the 9th; that afternoon the levee boards met and arranged to have work commenced the following day raising and strengthening the levees. A close watch was kept on the levees throughout the district, and they were strengthened as much as possible. At the close of the month the temporary levees along the commercial front of New Orleans were 2 to 5 feet high, and in many places the water was 12 to 18 inches above the height of the levees on the 9th, the date the warning for 21 feet was issued. No breaks had occurred so far in the levees along the Atchafalaya, notwithstanding the water stood 1.6 feet higher than ever recorded before. Several breaks occurred along the Bayou Lafourche. Only one break had occurred in the levees of the Mississippi proper between the mouth of the Red River and New Orleans, and that one is almost 40 miles above New Orleans, known as the Hymelia crevasse. Other breaks would have occurred, however, had it not been for the prompt action taken by the levee board as a result of the timely warnings issued by the Weather Bureau. An illustration of the value of every crevasse prevented may be taken from the Hymelia crevasse, 40 miles from New Orleans, on which over \$100,000 had been spent in efforts to close the break, and ultimate success was still very doubtful, and if successfully closed at least as much more must be expended. Praises for the Weather Bureau, as a result of these warnings, were heard on all sides,

both from the press and the people. As soon as information can be gathered a full report on the flood will be made.—*I. M. Cline, Forecast Official.*

#### CHICAGO FORECAST DISTRICT.

Advisory messages were sent out as usual during the month to open ports on Lake Michigan in advance of approaching storms of considerable energy. The most severe storm of the month developed in the Southwest during the 21st, and moved slowly northeastward, reaching Lake Michigan on the 23d–24th. It was accompanied by snow and a westerly gale. Warnings were issued on the morning of the 23d, about twelve hours in advance of the storm; and, as no casualties of any kind were reported, it is probable that vessel masters profited by the advice given.

A cold wave developed in the British Northwest during the night of the 11–12th. Cold-wave warnings were ordered for North Dakota on the 11th, and for South Dakota, Nebraska, Minnesota, and northwestern Iowa on the 12th. The cold wave was practically confined to these limits, although a decided fall in temperature occurred over the greater portion of the district. Another cold wave appeared in the British Northwest on the morning of the 18th, and gradually overspread the entire district, reaching the eastern limits on the morning of the 21st. Ample warnings of its approach were issued; shippers, railroads, and other transportation companies being notified well in advance.—*H. J. Cox, Professor of Meteorology.*

#### DENVER FORECAST DISTRICT.

Severe weather prevailed in Wyoming and eastern Colorado from the 18th to the 23d, but with this exception the conditions, as regards temperature and precipitation, were such as are commonly noted during March.

The storm of the 18th, which was attended by snow and low temperatures in Wyoming and eastern Colorado, was forecast the preceding morning. This low area, which was persistent in the middle Plateau from the morning of the 12th until the night of the 17th, gave excessive cloudiness and an unusual amount of fog, but very little precipitation. Early in the morning of the 18th warnings of a cold wave, with high winds and snow, were sent to points in Wyoming and northeastern Colorado, and railroad interests were promptly advised. The snowfall was heavy, and being attended by a northerly gale, business and transportation were brought to a standstill, especially in north-central Colorado. The low temperatures that followed were rather severe to range stock interests.—*F. H. Brandenburg, Forecast Official.*

#### SAN FRANCISCO FORECAST DISTRICT.

The month opened with generally pleasant weather throughout California, quickly followed by a moderate storm over the northern portion of the State. Southwest storm warnings were displayed at Point Reyes at 8 p. m. on the 2d, but were not verified. Warnings of high southerly winds were sent to stations in Nevada and southern California; high winds prevailed on the 3d and the warnings must be considered as late. A moderate depression over the Sierra caused general rains in California and snow in Nevada; in the vicinity of Los Angeles unusually heavy rains fell. Heavy frost occurred on the morning of the 6th. Another disturbance prevailed on the coast on the 8th, and was also accompanied by generous rains throughout the entire State. Southeast storm warnings were displayed from Point Reyes to Eureka, and were verified, high southerly winds prevailing along the coast. On the 12th a rainfall of 2.32 inches was reported at Eureka. A marked disturbance prevailed over California and Nevada on the 13th; rain fell over the entire State and thunderstorms occurred in

the interior. The weather continued unsettled and showers fell on nearly every day in some portion of the State. A hail-storm occurred at San Francisco on the 16th. From the 17th to the 21st the weather was fair. Another disturbance appeared over Nevada on the 23d and, as in previous cases, was accompanied by general rain. At Los Angeles a rainfall of 3.32 inches was reported for the twenty-four hours ending 5 a. m., 25th. The weather continued unsettled during the rest of the month. Southeast storm warnings were displayed from Point Lobos on the 27th, and were verified. The month as a whole was an unusually stormy one; the rainfall much exceeds that of an average March. No serious frosts occurred and the damage to fruits was slight.—*A. G. McAdie, Professor.*

#### PORTLAND, OREG., FORECAST DISTRICT.

The storms of March passed inland farther south than usual and only one severe storm visited the North Pacific States during the month. It made its appearance over western British Columbia on the morning of the 9th, and storm warnings were immediately ordered at all stations in the district. The gale reached its height about twenty-four hours later, when maximum velocities of 90 miles at North Head and 68 miles at Tatoosh Island were recorded. Other storms occurred on the 6th, 26th, and 30th, for which warnings were displayed in time to be of benefit. Frosts were reported quite frequently during the last half of the month and were accurately forecast.—*E. A. Beals, Forecast Official.*

#### AREAS OF HIGH AND LOW PRESSURE.

*Movements of centers of areas of high and low pressure.*

Number.	First observed.			Last observed.			Path.		Average velocity.	
	Date.	Lat. N.	Long. W.	Date.	Lat. N.	Long. W.	Length.	Duration.	Daily.	Hourly.
<b>High areas.</b>										
I.....	27, a. m.*	51	114	4, a. m.	48	54	Miles. 4,200	Days. 5.0	Miles. 840	Miles. 35.0
II.....	2, p. m.	50	110	7, p. m.	46	60	2,650	5.0	530	22.1
III.....	6, p. m.	38	122	10, a. m.	46	60	3,400	3.5	971	40.4
IV.....	8, p. m.	41	124	12, p. m.	39	75	2,925	4.0	731	30.5
V.....	9, a. m.	51	114	16, a. m.	46	60	2,600	3.5	714	29.8
VI.....	11, p. m.	54	114	16, a. m.	46	60	2,800	4.5	622	25.9
VII.....	17, p. m.	54	114	23, p. m.	46	60	4,100	6.0	683	28.4
VIII.....	21, a. m.	51	120	26, p. m.	35	76	3,100	5.5	564	23.5
VIII.....	26, a. m.	53	108	30, a. m.	46	60	2,800	4.0	700	29.2
Sums.....							28,475	41.0	6,355	264.8
Mean of 9 paths.....							3,164		706	29.4
Mean of 41.0 days.....									694	28.9
<b>Low areas.</b>										
I.....	4, p. m.	39	120	8, a. m.	39	85	2,700	3.5	771	32.1
II.....	17, a. m.	38	114	20, p. m.	45	80	2,375	3.5	678	28.2
III.....	22, a. m.	29	95	23, a. m.	38	80	1,100	1.0	1,100	45.8
IV.....	23, p. m.	45	88	25, a. m.	48	68	975	1.5	650	27.1
V.....	28, a. m.	48	123	31, p. m.	46	60	3,000	3.5	857	35.7
VI.....	28, p. m.	25	82	31, p. m.	46	60	2,000	3.0	667	27.8
Sums.....							12,150	16.0	4,723	196.7
Mean of 6 paths.....							2,025		787	32.8
Mean of 16.0 days.....									759	31.6

\* February.

For graphic presentation of the movements of these highs and lows see Charts I and II.—*Geo. E. Hunt, Chief Clerk, Forecast Division.*

#### RIVERS AND FLOODS.

The river conditions during March were exceptional and noteworthy, and the month will always be memorable for the general character and widespread extent of its floods. While the precipitation was not excessive, except in Louisiana and southeastern Texas, yet its periodic distribution was such that